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Multidisciplinary treatment in a case of loss of posterior vertical dimension

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Abstract Traumatic occlusion due to anterior crossbite malocclusion, missing posterior teeth and generalized moderate chronic periodontitis were some of the problems presented by this 58-year-old patient. The problems also included high mobility of the maxillary left central incisor, high gingival recession with attachment loss and periodontal deep pockets. The loss of supporting periodontal tissue was more evident on the maxillary left central incisor which was due to the traumatic position of the tooth aggravated by a forced anterior position of the mandible and a non-adjusted crown that promoted bacterial plaque accumulation. The absence of mandibular posterior teeth also worsened the clinical situation. Orthodontic treatment was performed only on the mandibular arch and implant anchorage devices were used to accomplish lingual inclination of the mandibular incisors. The definitive prosthetic treatment allowed reestablishment of appropriate esthetics on the maxillary anterior teeth with posterior stable occlusal contacts and eliminating the occlusal trauma. This condition promoted periodontal health of the left central incisor that remained stable over a 7-year follow-up. This clinical procedure with a long-term follow-up demonstrated that multidisciplinary management including orthodontics, implants and prosthetics can improve a debilitated traumatic occlusion and a severely periodontal compromised tooth.

Keywords Periodontics · Orthodontics · Implants · Traumatic occlusion

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Introduction

Loss of the vertical posterior dimension can worsen periodontal disease in anterior teeth regions caused by strong anterior contacts and consequently bone loss [1–3]. Additionally, if the patient originally presents with dental and/or skeletal orthodontic problems, the severe loss of periodontal tissue worsens or affects such problems [4]. One of the main objectives of the orthodontic treatment is improvement of the periodontal status by creating a healthy physiological typology in the alveolar bone through alterations in radicular positioning and a balanced occlusion [5].

Orthodontic treatment is complicated in patients with malocclusions and many missing or periodontal compromised teeth. There are no contraindications for orthodontic treatment in patients with periodontal disease, as long as the disease is under control [3, 4, 6]; nevertheless, if bone loss around the affected tooth is significant the orthodontic goals and mechanics should be modified with the help of restorative, prosthodontic and/or dentofacial surgical procedures [3, 4, 7]. Implants in the edentulous areas to provide orthodontic anchorage and later serve as a prosthetic support are considered a correct interdisciplinary approach [4, 8–11].

Fig. 1 **a–c** and **e, f** Intraoral photo before orthodontic treatment, frontal, lateral and occlusal photos. **d** mandibular incisor appearance when in a relaxed state

Case presentation

A 58-year-old man complained of the unesthetic appearance of the protruding mandibular teeth and functional aspects of the masticatory system (Fig. 1).

The patient had a Class III malocclusion with mandibular incisor protrusion, vertical overclosure and anterior functional mandibular positioning secondary to multiple missing posterior teeth (Fig. 1). In the first quadrant there was a non-conventional metal ceramic fixed partial denture with the first and second premolars attached to occlusal surfaces of the canine and first molar and in the second quadrant there was a conventional fixed partial denture between the canine and first molar. The patient's facial appearance showed collapsed lips with a mandibular incisor appearance when in a relaxed state. An inverted incisor position was present with a positive discrepancy of the mandibular teeth due to incisor proinclination aggravated by loss of vertical dimension and caused by missing teeth in the posterior mandibular arch. Both left and right canines showed a Class I dental relationship with a canine crossbite tendency on the right side. The mandibular dental midline showed 2 mm deviation to the right in relation to the maxillary dental midline.

Fig. 2 Pretreatment panoramic radiograph demonstrating severe destruction of the alveolar bone in the maxillary left central incisor

A generalized moderate chronic periodontitis was present, namely on the left maxillary central incisor that had attachment loss with deep periodontal pockets of 5–6 mm on the mesial and distal interproximal face and 4 mm on the vestibular and palatal faces. The high gingival recession throughout the face led to a less favorable crown-root ratio (Figs. 1 and 2). Due to this poor condition and high mobility, the left central incisor was retained with the adjacent teeth on the palatal surface

with a wire and composite and extraction was planned during the rehabilitation stage at the end of orthodontic treatment.

In centric relation (CR) the occlusion showed an improvement in the horizontal overlap with the incisors placed edge to edge, so there was a functional anterior positioning of the mandible due to the multiple missing posterior teeth and vertical overclosure of the occlusion (Fig. 3).

In the cephalometric analysis at maximum intercuspidation (Fig. 4) the patient had a skeletal Class III relationship (Na-Pog/point A = – 1.6 mm) due to the anterior position of the mandible. The vertical occlusion dimension was decreased. The mandibular incisors were proinclined (Incisor Mandibular Plane Angle (IMPA) = 105.8°) as well as the maxillary incisor, so the interincisal angle was low (111.7°). The horizontal overlap was negative (–2 mm) and the vertical overlap was normal (3.4 mm).

Treatment objectives

The treatment goals established for this patient were

1. generalized periodontal disease treatment,
2. orthodontic treatment of the mandibular arch with maximum anchorage with implants and temporary crowns to increase the vertical dimension,
3. definitive prosthetic restoration to provide retention of orthodontic posttreatment preventing occlusal trauma and restoring masticatory function and
4. anterior incisor esthetic restoration.

Treatment alternatives

Treatment options included endodontic treatment for the central and lateral maxillary incisors and canine on the right side, extraction of the maxillary left central incisor replaced by a partially fixed dental prosthesis from the maxillary right canine to the left canine with protruding crowns in order to correct the horizontal overlap. However, this option was not chosen because the vertical dimension and the traumatic forces on the incisors would not be corrected and an excessive incisor protrusion was not recommended. Excessive traumatic forces

Fig. 3 Dental casts mounted in a SAM3® articulator

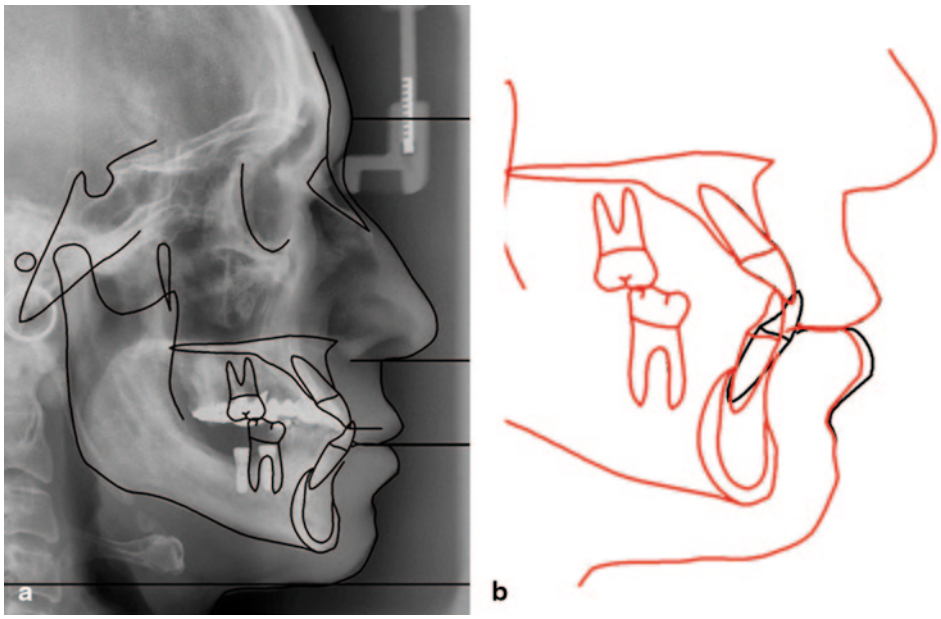

Fig. 4 **a** Pretreatment lateral cephalometric radiograph and tracing in maximum intercuspidation demonstrating the inverted anterior occlusion and high proinclined mandibular incisors. **b** Visual objective of treatment (VTO) with the movement of the mandibular incisor from the intercuspidation position

could result in enhanced levels of inflammation and periodontal deterioration in the presence of plaque [12]. Also, more flaring of maxillary incisors could be induced by physiological forces acting on these teeth, when there is a substantial loss of alveolar bone even in situations where no loss or a subtle loss of occlusal vertical dimension (OVD, [2]) occurs.

Treatment

Periodontal treatment with supragingival and subgingival scaling was carried out prior to orthodontic treatment. Due to the poor condition of the maxillary left central incisor and the indications for extraction this tooth was not submitted to any surgical periodontal treatment.

Anchorage for orthodontic movement would be provided by osseointegrated endosseous titanium implants that were placed in the third and fourth quadrants (Fig. 5). Additional temporary crowns would also be placed in order to increase the OVD allowing for orthodontic retroinclination of the mandibular incisors (Fig. 5). The OVD was increased by approximately 2 mm by using temporary restorations over the implant support.

Because there was no dentomaxillary disharmony (DDM) of the maxillary arch and also due to the compromised anterior teeth, namely the maxillary left central incisor, the fixed appliance (0.022 inch slot) was applied only on the mandibular arch due to positive DDM and labial tipping of the mandibular incisors. First, alignment and tooth leveling with a sequence of 0.014 and 0.018 inch nickel-titanium arches, later replaced by 0.016 × 0.022 inch and 0.018 × 0.025 inch steel arches was decided to close the incisor spaces by using an elastic chain and then a closed coil-spring was placed on the third and fourth quadrants between the distal face of the mandibular lateral incisors and the brackets that were positioned on the vestibular face of the temporary crowns supported by the implants (maximum anchorage; Fig. 5). Also, it was necessary to put additional negative torque on the canines and premolars on both sides in order to improve the occlusion. Orthodontic treatment took approximately 18 months. A 0.0175 inch braided wire was bonded at the lingual surfaces of the mandibular incisors and the canine teeth for orthodontic treatment stabilization. After the orthodontic treatment a periodontal evaluation was performed to determine the definitive prosthetic plan for the maxillary left central incisor. It was decided not to extract this tooth due to a great improvement in the mobility as well as in the periodontal deep pockets that were reduced; consequently the endodontic treatment was improved for the left central tooth and individual crowns were placed on this tooth as well as on the adjacent lateral incisor. In the first quadrant the metal ceramic crown rehabilitation remained the same. In the second quadrant a new metal ceramic partially fixed denture was applied to replace the existing one.

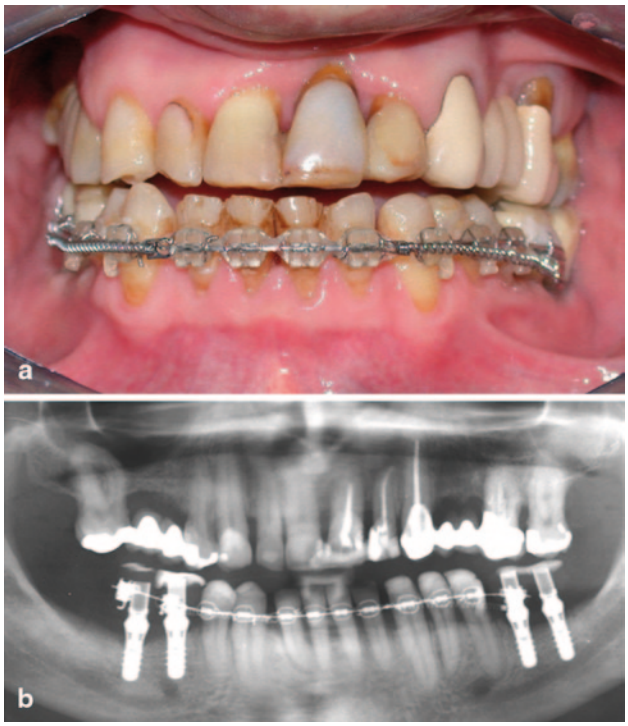

Fig. 5 **a** Intraoral photograph during mandibular incisor retraction with close Niti coils in a 0.018 inch and 0.025 inch arch, **b** panoramic radiograph during the retraction of the mandibular incisors with anchorage in osseointegrated endosseous titanium implants with temporary crowns in mandibular posterior region

Results

A normal interarch relation was established on both sides. The collapse of the posterior occlusion and mandibular incisor proinclination was eliminated (Figs. 6 and 7).

The periodontal control at the end of the multidisciplinary treatment showed stable positioning of the maxillary left central incisor. Stable posterior occlusal contacts were established and the balancing interferences were eliminated. At the end of the treatment the cephalometric analysis showed that the mandibular incisor inclination and the horizontal overlap had improved as well as the anteroposterior dimensions and the overclosure of the occlusion with an increase in vertical dimension (Fig. 7). A stable occlusion was observed 3 (Fig. 8) and 7 years after the orthodontic treatment (Figs. 9 and 10).

A periodontal condition was accomplished through manual measures and compared with initial values. The deep periodontal pockets on the left central incisor were reduced to healthy values of approximately 3 mm on the mesial and distal interproximal faces and 2 mm on the vestibular and palatal faces and the gingival bleeding index was reduced to zero.

Fig. 6 Intraoral photo after orthodontic treatment and prosthetic rehabilitation. **a, c–d**, frontal and occlusal photos. **b** smile

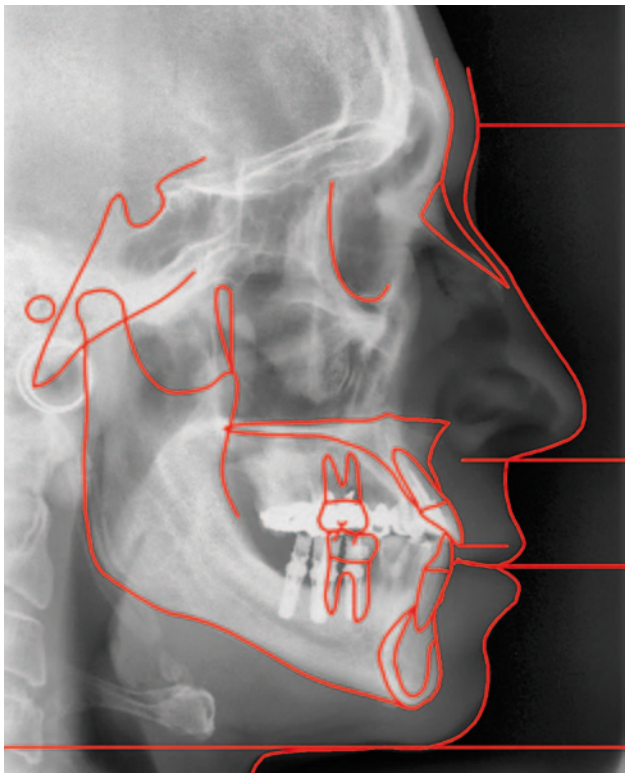

Fig. 7 Post-treatment lateral cephalometric radiograph and tracing in maximum intercuspidation after orthodontic treatment

Fig. 8 Intraoral photograph 3 years after orthodontic treatment

Discussion

The theory that increased tooth mobility can worsen periodontal disease has been revised. Ericsson and Lindhe [13] underlined this in an animal study and showed that the accumulation of periodontal pathogens is the reason for enhanced levels of inflammation and periodontal deterioration and not a traumatic occlusion. If a patient suffers from a combination of occlusal trauma and periodontal pathology, periodontal therapy has absolute priority to reduce inflammation and infection and orthodontic therapy is performed afterwards. In spite of no orthodontic intervention on the maxillary arch as well as no corrective phase of the periodontal surgical therapy of the maxillary left central incisor, there was a significant reduction of deep periodontal pockets on all faces of this tooth after orthodontic treatment. Therefore, in spite of the bacterial etiology of the periodontal disease, in the present case the occlusal trauma was an important risk factor in the worsening of this condition. This is in accordance with other studies which found that orthodontic treatment can eliminate a traumatic occlusion and modify infrabony defects, obtaining probing depth reduction as well as bone defect radiological resolution [14, 15]. In addition to regular control of soft tissue inflammation it is important to prevent excessive tooth mobility. The

Fig. 9 Intraoral photo 7 years after orthodontic treatment. **a–e** frontal, lateral and occlusal photos

Fig. 10 Posttreatment panoramic x-ray (**a**) and periapical x-ray (**b**) demonstrating significant improvement of the alveolar bone in the upper left central incisor

occlusal trauma, also allows increased vascularization, vascular permeability and osteoclast activity during the traumatic event. Therefore, occlusal forces that produce excessive tooth movement aggravate active periodontitis and accelerate the loss of connective tissue attachment. One way to control occlusal forces during orthodontic therapy is through disarticulation of the displaced teeth. The temporary crowns that increased vertical dimension were used to establish the centric relation as required and acceptable throughout orthodontic treatment to prevent excessive tooth mobility and allow orthodontic mandibular incisor retroinclination. The close coil-springs that were used to close the mandibular spaces were important to apply light orthodontic forces to the periodontally compromised teeth in this way minimizing further attachment loss, tipping movement and root resorption [16]. Currently, dental implants have become predictable and reliable adjuncts for oral rehabilitation and have been successfully reported in many clinical situations, such as intruding teeth and eliminating a trau-

matic occlusion [4]. Also miniscrew implant anchorage provides a valid treatment option for patients where conventional implants are not indicated [3, 4].

In the present case an important increase in the vertical dimension was crucial in order to avoid the collapse of the occlusion as well as the functional anterior position of the mandible. The osseointegrated endosseous titanium implants on the posterior mandibular area with temporary crowns were essential to increase the vertical dimension, allowing retroinclination of the mandibular incisors through orthodontic forces only applied on the mandibular arch. Also, the mandibular position was stabilized with this approach; nevertheless, the temporary crowns increased occlusion and the definitive prosthetic plan was determined to provide retention of orthodontic posttreatment results to prevent occlusal trauma and to restore the esthetics of the maxillary incisors.

Dentitions with reduced periodontal support show a marked tendency to return to the pretreatment position following active appliance therapy; however, a correct horizontal overlap and vertical overlap at the end of the treatment were also indispensable to stabilize the dental relation. The gingival recession on the vestibular face did not decrease at the end of the treatment; however, no bony destruction occurred on the interproximal face as seen in the radiographs 7 years after the orthodontic treatment (Fig. 10).

In the past it was assumed by authors that there were indications for a graft when keratinized gingival levels were less than 2 mm [17–19] but in the present case no gingival graft was performed in spite of a keratinized gum level that was less than 2 mm. As stated in recent studies minimum bands of attached gingiva with periodontal health can be maintained without progression of the recession if brushing trauma and inflammation are controlled [20]. Also, the patient presented a lower smile line and the esthetics would not be compromised.

Conclusion

This clinical procedure with a long-term follow-up demonstrated that multidisciplinary management including orthodontics, implants and prosthetics can improve a debilitated traumatic occlusion and a severe periodontal compromised tooth. The orthodontic treatment should be performed before treatment of the deep periodontal pockets in a traumatic occlusion because excessive traumatic forces could result in enhanced levels of inflammation and periodontal deterioration in the presence of plaque. Also, an inverted incisor occlusion and flaring of mandibular incisors could be induced by physiological forces acting on these teeth, especially in cases with a substantial loss of alveolar bone. This is generally aggravated when there is a decrease in OVD due to missing posterior support.

Conflict of interest

The authors declare that there are no actual or potential conflicts of interest in relation to this article.

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